



POTENTIAL BENEFITS AND CHALLENGES OF USING AI IN EDUCATION

Mr. Syed Tawseef Ahmad

M. A. Psychology, M. Ed., University of Kashmir

ABSTRACT

Sustainable education plays a vital role in fostering a sustainable future, although it confronts several significant obstacles, such as inadequate infrastructure, scarce resources, and a lack of awareness and engagement. The integration of artificial intelligence (AI) can tackle these challenges and improve sustainable education by enhancing access to quality learning, crafting personalized educational experiences, and facilitating data-driven decision-making. One advantage of employing AI and information technology (IT) systems in sustainable education is the ability to offer students tailored learning experiences that align with their individual learning styles and preferences. Furthermore, AI systems can equip teachers with data-driven insights regarding student performance, emotions, and levels of engagement, allowing them to adjust their teaching methods and strategies or provide necessary support and interventions. Nevertheless, the implementation of AI and IT systems in sustainable education brings certain challenges, such as concerns about privacy and data security, in addition to potential biases present in algorithms and machine learning models. Additionally, the establishment of these systems demands substantial investments in technology and infrastructure, which can pose difficulties for educators. The shift from conventional classroom teaching to online, virtual, and blended approaches is unavoidable. Numerous studies focus on how Technology Enabled Learning (TEL) can enhance overall learning efficiency and engagement. As more courses are offered online and are made accessible from a distance, the complexity of managing the data generated by these systems increases. The use of big data analysis alongside AI has become common in exploring information technology within educational frameworks. Various authors have discussed different areas and uses where AI can provide valuable insights and support for further research. When examining how AI can assist Intelligent Tutoring Systems (ITSs) in fostering sustainable education, it is sensible to assess various implementations using a standardized framework that helps researchers obtain a solid understanding and support for sustainable educational practices. In this research article, I plan to explore various viewpoints from educators and IT solution architects to bridge the gap between education and AI technology. The areas of discussion will encompass concepts and challenges of sustainable education, technology utilization and outcomes, as well as future research directions. By addressing these issues and advancing further research, we can tap into the full potential of these technologies and foster a more equitable and sustainable education system.

KEYWORDS: Artificial Intelligence, Education, Intelligent Tutoring Systems, Virtual Reality, AI Learning Models, Multidisciplinary Education

INTRODUCTION

AI integration with tutoring systems can be divided into two primary categories. The first category involves not interfering with the tutoring system and instead extracting log data for subsequent analysis. This approach generally relies on extensive data mining and clustering techniques to uncover learning behaviours. Since there is no definitive ground truth data to train the model, unsupervised learning methods and clustering algorithms are typically employed for categorizing these behaviours. The second major approach focuses on performance prediction, which includes feature extraction and machine learning algorithms through supervised learning. This latter category of AI integration with tutoring systems is usually more challenging to execute. In such implementations, personalization tends to be more effectively managed in terms of learning processes or interventions. Here, it is essential to consider the system architecture and potential inflexibilities, as the AI algorithm is closely integrated with the system, representing a form of adaptive learning application. AI-integrated ITSs may demonstrate improved adaptability,

allowing them to respond more effectively to students' real-time learning conditions while having a greater opportunity to provide timely assistance when needed.

In this way, the deep integration of AI within education is emerging as an unavoidable trend for the future landscape of learning. The societal shifts triggered by this technological revolution are continually reshaping the existing methods and content of education. This is the reason we believe that education is gradually transitioning into an era where artificial intelligence is increasingly present in classrooms. Current AI education trends encompass the use of AI-enhanced tools that alleviate teachers' workloads, the creation of intelligent tutoring systems, the deployment of chatbots to assist students, and the incorporation of machine learning and natural language processing (NLP) into educational resources, along with AI applications that aid teachers in grading or assessing students and in training tools for educators. Developing an education-based solution that leverages artificial intelligence necessitates establishing and executing a technological infrastructure that

integrates AI into various facets of the educational process. AI-based solutions for education encompass a wide array of applications and technologies that utilize AI capabilities to enhance teaching and learning processes. These encompass: Natural Language Processing (NLP), Intelligent Tutoring Systems, Learning Analytics, Adaptive Learning Platforms, Virtual Reality (VR) and Augmented Reality (AR), Intelligent Content Creation, Automated Grading and Feedback, Intelligent Course Recommendations, Data-Driven Decision-Making, Speech Recognition, and Language Learning. The AI tools provide formatting, style-checking, and editing support for academic papers. One significant benefit is their capacity to swiftly and effectively analyze and rectify language mistakes, thus enhancing the readability and clarity of manuscripts. However, there are also drawbacks linked to employing AI tools in the scientific writing process. A primary concern related to this topic is the lack of clarity regarding students' utilization of AI in the writing process, which could lead to ethical dilemmas. This raises the question, "Can an artificial intelligence chatbot be regarded as the author of a scholarly article?" Currently, AI chatbots cannot be considered authors of academic papers, not only from a copyright standpoint but also from a research ethics perspective.

Nonetheless, Generative Artificial Intelligence (GenAI) gained public interest in late 2022 with the introduction of ChatGPT, which has become the fastest-growing app to date. These GenAI applications, capable of emulating human abilities to produce outputs such as images, text, music, videos, and software code, have ushered in a significant transformation across the educational sector. Presently, GenAI tools are increasingly accessible to the public, and the release of iterative versions exceeds the capacity of national legal frameworks to adapt. Nonetheless, the effects of artificial intelligence on the teaching and learning processes have been highlighted by bibliometric research based on Science Direct, showing that the examination of "the impact of artificial intelligence on the teaching and learning process" has become a popular topic in academia, particularly since 2022.

Furthermore, the development and application of AI in education are prioritized on the agendas of both the UN and the EU. In light of the recent surge in AI, UNESCO's Deputy Director General for Education, Stefania Giannini, emphasized that the late 20th and early 21st centuries witnessed a significant digital transformation. According to her, this era can be characterized by several key events: the introduction and widespread adoption of personal computers; the growth of the internet and online search capabilities; the emergence and impact of social media; and the increasing prevalence of mobile computing and connectivity. The current state of the world reveals that not everyone, nor every nation, has experienced these technological advances uniformly.

While many of us are still grappling with the profound social and educational effects of these past revolutions, we have found ourselves thrust into yet another digital transformation, which Giannini refers to as the 'artificial intelligence revolution'. In May 2023, UNESCO convened the inaugural global meeting of

education ministers to share insights regarding the influence of generative AI tools on teaching and learning. This conference resulted in the creation of a roadmap to steer global policy discussions with governments and collaborators from academia, civil society, and the private sector. Given that "the absence of national regulations on GenAI in most countries leaves the data privacy of users unprotected and educational institutions largely unprepared to validate the tools", UNESCO released its "Guidance for generative AI in education and research", which serves as the first international guidance on GenAI within the educational sphere.

In the introduction of this guidance, Stefania Giannini emphasized that as generative AI (GenAI) tools progressively automate fundamental writing and art creation tasks, they compel education policymakers and institutions to rethink the purpose, content, and methods of learning. She asserted that this "new phase of the digital era" necessitates a reevaluation of our traditional concepts of knowledge and human learning through the lens of artificial intelligence. This guidance evaluates the potential risks posed by GenAI to essential humanist values such as human agency, inclusion, equity, gender equality, linguistic and cultural diversity, as well as the pluralism of opinions and expressions. Following the introduction, the document outlines key actions for government agencies regarding the regulation of GenAI tools, which include enforcing data privacy protections and establishing age restrictions on their usage. Additionally, the Guidelines detail the criteria that GenAI providers must meet to ensure their ethical and effective implementation in educational settings. Lastly, it provides actionable recommendations for policymakers and educational institutions on how to utilize GenAI tools in a manner that safeguards human agency while delivering genuine benefits to students, teachers, and researchers.

In this context, it is essential to reference the report released by the OECD titled "Opportunities, Guidelines, and Guardrails on Effective and Equitable Use of AI in Education" (OECD, 2023). These guidelines aim to assist educational jurisdictions and organizations representing both teachers and educators in navigating the swift advancements in artificial intelligence. The guidelines build upon the OECD's "Council Recommendations on Artificial Intelligence" (2019) and the "Broadband Connectivity" (2021). The conclusions of the paper stress that education systems should provide learners, teachers, and stakeholders with access to human assistance in addition to AI-supported tools to effectively tackle challenges and offer alternatives when necessary. Regarding inequalities in education caused by uneven access to technology, variations in usage, and difficulties in ensuring the quality of digital resources, the authors argue that these issues must be resolved to avoid further marginalization of underprivileged students. Furthermore, the paper emphasizes the need for teachers to receive professional development training and support to effectively integrate digital resources into their teaching practices, highlighting the significance of collaborating with researchers for evidence-based strategies.

As for research initiatives involving educators, it is

recommended that they concentrate on how technology aids both students and teachers, evaluating its effects on equity and quality in educational environments. At the European level, addressing the challenges associated with the use of artificial intelligence in education has been prompted by the series of issues arising from the COVID-19 pandemic. To support the adaptation of Member States' education and training systems to the digital age, the EU established the Digital Education Action Plan 2021-2027 on September 30, 2020. This plan encompasses two strategic priorities: 1) Promoting the establishment of a high-performing digital education ecosystem, and 2) Advancing digital skills and competencies for the digital transformation. These guidelines consist of 13 actions, including the Digital Education Action Plan (Action 6). In this framework, the EU created and published the Ethical Guidelines on AI and data usage in teaching and learning for educators in October 2022, providing a practical resource intended to help educators comprehend the potential benefits of AI applications and data usage in education and to increase awareness of possible risks, enabling them to engage with AI systems positively, critically, and ethically while optimizing their full potential.

In other words, providing real-time instructional feedback can be advantageous if it aids both students and teachers in their improvement. However, common experiences often lead students and educators to feel negatively about assessments, creating a notable tension between the possible advantages of data obtained through formative assessments and the practical challenges associated with implementing additional assessments in educational settings.

Some AI-driven systems and tools aim to mitigate this conflict. For instance, one AI-based reading tutor listens to students as they read aloud and offers immediate feedback to enhance their reading skills. Students have reported that they enjoyed reading aloud, and this method has proven effective. Furthermore, researchers have integrated formative assessments into games, allowing students to demonstrate their understanding of Newtonian physics while progressing through increasingly challenging game levels. If students can easily request and receive assistance when they experience frustration or confusion, it can help diminish those feelings and promote a more positive learning environment. The feelings of safety, confidence, and trust that students have in the feedback generated by these AI-enabled systems and tools are vital for effectively showcasing their learning.

Moreover, AI-enhanced formative assessments could also help save teachers' time, such as by reducing the amount of time spent on grading, which allows educators to focus more on aiding their students. Additionally, AI-enhanced assessments could prove beneficial for teachers by offering detailed insights into students' strengths or weaknesses that may otherwise go unnoticed and by facilitating instructional adjustments or enhancements by providing a limited set of evidence-based suggestions for helping students master the material. Such assessments might also be useful beyond the classroom by offering feedback when the teacher is unavailable, for instance, when students are completing homework or rehearsing a

concept during study hall.

In addition to that, AI models and AI-enabled systems may enhance formative assessments significantly. For example, a question format that encourages students to draw a graph or build a model can be evaluated using AI algorithms, allowing similar student models to be categorized for the teacher's analysis. Improved formative assessment may empower teachers to respond more effectively to students' comprehension of concepts like "rate of change" in complicated, real-world scenarios. AI can also provide learners with feedback on intricate skills, such as acquiring Chinese or German sign language or mastering any other foreign language, as well as in other situations where immediate human feedback is not available.

Overall, an AI assistant can potentially lessen the burden on teachers concerning grading simpler elements of student responses, enabling them to concentrate their expert judgement on more critical aspects of an entire essay or a complex project. We might also enhance the accessibility of feedback. For example, an AI-enabled learning tool may be able to engage verbally with a student regarding their essay response, posing questions that help the student clarify their argument without needing to read from a screen or type on a keyboard. In the previous examples within the learning section, we observe that AI can be integrated into the learning process, offering feedback to students as they work through a problem instead of only afterwards when a student has arrived at an incorrect answer. When formative assessments are more integrated, they can more effectively support learning, with timely feedback being essential. Although there are numerous intersections between AI and formative assessments, our listening sessions also highlighted attendees' interest in addressing some existing limitations in the realm of formative assessment, specifically the time-consuming and sometimes burdensome nature of taking tests, quizzes, or other assessments, as well as the lack of perceived benefit from the feedback loop by educators and students alike.

CONCLUSION

The rapid advancement of digital applications and their unrestricted application across various domains, including education, has raised alarms and highlighted the necessity for regulatory frameworks. On March 13th, 2024, the European Parliament ratified the Artificial Intelligence Act. This legislation aims to safeguard fundamental rights, democracy, the rule of law, and the environmental sustainability of high-risk AI while fostering innovation and positioning Europe as a leader in this sector. The regulation establishes responsibilities for AI based on its possible risks and impact level. Although numerous challenges must be addressed before AI becomes a standard feature in education, the most significant dangers often relate to security, privacy, and ethical considerations. As AI continues to expand within the educational environment, various regulatory organizations and communities are emphasizing these issues. For example, UNESCO has introduced a mandate advocating for a human-centric approach to AI, urging entities to use AI responsibly and maintain human

involvement in the training process. Additionally, UNESCO has created a framework for the Beijing Consensus that underscores governance policy recommendations for those employing AI in educational contexts. Furthermore, the World Economic Forum has pinpointed several critical changes needed to improve educational quality in the age of AI. As innovative forms of AI, including generative AI and large language models, rapidly gain traction, the potential of this technology in education is on the rise. We are still in the process of understanding how AI technologies will be integrated into the education sector in the forthcoming years.

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